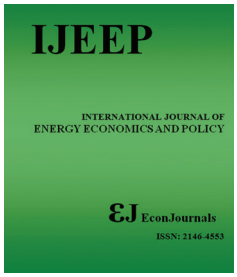

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Understanding Citizens' Perceptions and Attitudes toward Energy Restructuring under China's NDC for Quality of Life: A Case of Linfen City

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ABSTRACT

China updated its NDC in 2020, pledging to achieve carbon peaking before 2030 and achieve carbon neutrality by 2060. To achieve these targets, China must revise its energy mix planning to increase energy security and meet the demand for low-carbon energy production to combat climate change. Linfen is one of the most important economic cities in Shanxi Province, which is one of China's most important coal-producing regions and is plagued by high pollution and high energy consumption. Linfen was chosen as the city of interest for this study due to being a coal hub and one of the most polluted cities in the nation. To ensure effective policy implementation, it is essential to investigate citizens understanding and integrate their perceptions into policy formulation. Therefore, the purpose of this study is to investigate the perceptions and attitudes of Linfen citizens regarding China's National Determined Contributions (NDCs) on energy transformation for enhancing quality of life. The questionnaire, containing 27 questions, was distributed online, and received 402 valid responses. The finding revealed that 72.14% of respondents indicated that people were concerned about climate change, and more than 80% agreed with the China NDC's target of increasing the use of renewable energy to reduce greenhouse gas emissions and achieve carbon neutrality. They also revealed that developing renewable energy projects based on China's NDCs could improve their quality of life while also boosting the city's economic and social benefits. Nevertheless, it was observed that 10.34% of the participants showed a limited knowledge of the local environmental regulations and China's NDCs. To achieve the government's goals of carbon neutrality by 2030, it is essential to increase the awareness, engagement, and education of Chinese citizens. This will facilitate successful carbon neutrality efforts and necessitate the implementation of public outreach programs that foster communication among diverse stakeholder groups at the local level.

Keywords: Public perceptions, Attitude, China's NDCs, Quality of life, Renewable energy
JEL Classifications: Q28, Q42, Q48

1. INTRODUCTION

Many nations have set their own nationally determined contributions (NDCs) goals to reduce greenhouse gas (GHG) emission and adapt to the effects of environmental changes in response to global climate change. China accounted for 28% of annual global carbon dioxide (CO_2) and a third of the world's GHG emission in 2022 due to being the world's largest producer and consumer of coal, especially for power generation (World Bank, 2023). In 2021, annual CO_2 emissions were 11.47 billion tons, with fossil fuel combustion for energy production and industrial production of materials accounting for the majority (Statista, 2023). Environmental, health, climatic, and resource issues are unavoidable as a result of the use of fossil fuels and air pollution (Liu et al., 2021; Cui et al., 2020; Lu et al., 2020; Rafindadi et al., 2014).

The combustion of fossil fuels, particular coal, contributed in the production of pollutants that pose significant environmental and

public health risks. These hazards have impeded the sustainable development of society, the economy, and the natural environment. This has a significant impact on the well-being of Chinese citizens. As the process of reducing carbon emissions increases, China must diversify its energy development, accelerate energy restructuring, and significantly increase the share of renewable energy (RE) in energy production and consumption. Almost 90% of China's GHG emissions are produced by the energy sector, putting energy policy at the center of the country's transition to carbon neutrality. The shift from fossil-fuel-based development to renewable energy sources (RES) is and will be critical in China's attempts to prevent climate change, promote sustainable development, and achieve a just energy transition (IEA, 2021; Chen et al., 2022). High-efficiency, clean, new, and low-carbon RES must be prioritized in new energy development.

The issue of climate change and the increasing demand for energy has prompted various countries to reevaluate their energy portfolios with the aim of identifying more reliable and greener energy sources. To mitigate the negative effects of climate change, global citizens need to adjust their energy consumption behaviors and develop RES (Keramitsoglou et al., 2016). Citizens must be engaged with the formulation of policy and the development of future energy portfolios (Oluoch et al., 2020). As key stakeholders, the public has the ability to influence decision-making at both the national and local levels. The involvement of public opinion has the potential to mitigate the challenges arising from the uneven allocation of benefits and obligations that are often associated with energy development (Almulhim, 2022). As a result, it is vital to develop and harness public knowledge about energy challenges. Evaluations of the general public's perceptions and understanding of energy-related issues help policymakers and other relevant stakeholders in formulating effective measures to address environmental concerns.

Linfen was chosen as the study area because Shanxi Province is China's largest coal-producing province, and Linfen is in Shanxi Province, which its pillar industry is coal mining. Linfen has a two-unit waste-coal-fired power station in Shanxi Province with a total capacity of 600 MW. China Datang owns the majority of the factory, which was built in 2010 for unit 1 and in 2013 for unit 3. (Power Technology, 2022). At the same time, Linfen has a large iron ore reserve and several steel mills (Liu et al., 2021). During the manufacturing process, a large amount of waste gas and wastewater are produced, endangering the lives of the residents. Linfen City suffers by high levels of pollution and energy consumption, which is a significant impediment to Shanxi Province's economic development (Song et al., 2021). Therefore, it is important to promote the development and application of low carbon technologies in Linfen, optimize the industrial structure and promote the transformation and modernization of traditional industries, in order to contribute to the sustainable and healthy development of Linfen and to provide experience for the economic development of Shanxi Province and other urban areas in China (Song and Li, 2020).

Existing studies on the perceptions and attitudes of citizens focus primarily on energy policies and RE projects, but there are less studies on the perceptions and attitudes of citizens regarding the use of RES to achieve NDCs targets as well as improving citizens quality of life. This paper aims to contribute to closing this gap by investigating Chinese citizens' perceptions and attitudes on the RE projects for energy transformation under China's NDCs and their impact on the quality of life. In addition, it seeks to determine the public's level of knowledge, its willingness to pay for RE, and their attitudes on the economic and social impacts of RE initiatives. This work intends to gain a better understanding of citizens' viewpoints and ways to push Linfen and China regarding energy transformation based on China's NDCs.

The remaining sections are organized as follows. In Section 2, the literature review is presented, focusing primarily on current energy policies in China, previous studies on perceptions and attitudes toward energy policies and RE projects, and quality of life. In Section 3 explains the methodology used to investigate the question of interest. In Section 4, the survey results and statistically analysis of citizens perceptions and attitudes towards China NDCs are carried out, and Section 5 concludes the paper with our key conclusions and policy recommendations.

2. LITERATURE REVIEW

2.1. Current Policy on Energy Sector in China

At the 75th session of the United Nations General Assembly, held on September 22, 2020, President Xi Jinping emphasized the need to accelerate the formation of green development and lifestyle, as well as the construction of an ecological sustainability, and for the 1st time proposed the "double carbon" goal—aiming for peak CO_2 emissions by 2030 and carbon neutrality by 2060 (Ministry of Foreign Affairs, the People's Republic of China, 2020; Wang and Zhang, 2020). On this pathway, the main factors of carbon reductions between now and 2030 are energy efficiency improvements, expansion of renewables, and coal use decrease. Between 2020 and 2060, about 80% of China's energy mix will be derived from renewable sources, primarily wind and solar panels (IEA, 2021).

On October 28, 2021, China submitted to the United Nations Framework Convention on Climate Change Secretariat the "Effectiveness of China's Implementation of Nationally Determined Contributions, New Goals, and New Measures" and "China's Long-Term Greenhouse Gas Low Emission Development Strategy in the Mid-Century," as well as updated the national Self-directed Contribution Goals (Wang et al., 2020). The updates to NDC are as follows:

- China has set carbon peaking and carbon neutrality targets before 2030 and 2060, respectively
- In 2030, carbon dioxide emissions per unit of GDP will be more than 65 percent lower than in 2005
- China aims to increase the share of non-fossil fuels in primary energy consumption to around 25%
- China aims to increase forest stock volume by 6 billion cubic meters from 2005 levels, and
- China aims to increase total installed wind and solar power capacity to more than 1.2 billion kilowatts by 2030.

Accordingly, China's commitment to carbon neutrality is more difficult than that of developed nations. In its NDCs, China confronts enormous challenges and obstacles, requiring enormous efforts. China, a developing nation with a population of 1.4 billion, confronts difficult challenges such as economic development, improvement of the quality of life for its citizens, environmental governance, and combating climate change. China, a country rich in coal but short on oil and gas, is currently undergoing a critical time of transforming its growth model, optimizing its economic structure, and shifting growth drivers. Energy consumption will continue to rise as industrialization and urbanization continue, but significant changes to the coal-dominated energy mix are unlikely in the short term (UNFCCC, 2022).

By implementing the anticipated citywide changes proposed by NDCs, the combustion of coal can be effectively reduced, thereby improving the living conditions and health of all city residents. China began full implementation of the "dual carbon" objective in 2021 (dual carbon goal: to reach carbon peak by 2030 and carbon neutrality by 2060) (Huang et al., 2022).

2.2. Review of RE Situation in Linfen

Linfen (35°23′36°57′ N, 110°22′112°34′ E) is a large industrial base in Shanxi Province, located in China's southwestern Shanxi Province and has a moderate continental climate, as shown in Figure 1 (Ji et al., 2023). It has an area of over 20,000 square kilometers and a permanent population of 3,976,481 in 2021. The GDP value has increased from the previous 190.947 RMB billion in 2021 to 222.79 RMB billion in 2022, with an annual GDP growth rate of 8.5%. The coal consumption in Linfen, the main industrial base of Shanxi Province, was approximately 43 million tons in 2018. In addition, Linfen is a prefecture in Shanxi Province, which is one of China's most important coal-producing regions and faces the problem of high pollution and high energy consumption, which is an important restriction for the economic development of Shanxi Province. As part of a nationwide effort to reduce air pollution, the local government enacted coal-burning pollution prevention regulations in 2017, designating certain areas as coal-free and imposing fines ranging from 20,000 to 200,000 yuan (US$3,200 to $32,000) on anyone who illegally burned coal after the regulations went into effect in 2018 (China Dialogue, 2017). In addition to the local government's efforts under the dual carbon policy, the city has a RE initiative.

Currently, Linfen has achieved initial progress in RE initiatives as a response to China's NDCs and dual carbon policy. The remarkable advancements in the field of clean energy are evidenced by the proliferation of projects involving wind power, photovoltaic systems, pumped storage, hydrogen fuel, and the ongoing enhancement of alternative energy sources. In 2021, the Shanxi provincial government granted approval for a solar photovoltaic project of 300 MW installation, situated in Quwo County, Linfen City, Shanxi Province. This project has been implemented in accordance with the national dual carbon strategy (China Power, 2022). In addition, there are 16 out of the 18-wind power and photovoltaic power generation projects approved by local government and have begun construction, including a 60 MW pilot project for Solar PV rooftop development in Huozhou and Xiangning (Shanxi Provincial Energy Bureau, 2021). Remarkable achievements have been made in energy transformation and new energy construction. The city's new energy power generation reached 1.64 billion kWh in the first half of 2022, a year-on-year increase of 23.31%.

2.3. Perceptions and Attitudes toward Energy Policies and Renewable Energy Projects

Several countries intend to use RES to mitigate climate change and air pollution caused by energy production. According to the recent special report by the Intergovernmental Panel on Climate Change (IPCC), mitigating the detrimental impacts of climate change will require expeditious and extensive alterations to all societal domains, particularly those pertaining to energy production and consumption (IPCC, 2022). Public engagement is a crucial aspect of restructuring a nation's energy infrastructure, particularly in a democratic society. In several nations, there exists a significant level of societal acceptance towards sustainable energy policies and the implementation of RE systems. Public perceptions and responses to new energy technologies studies attempt to analyze, characterize, and explain what the public knows and believes about these technologies—and, equally important, how they have responded or may respond to their implementation (Boudet, 2019). Understanding public perceptions and responses to new energy technology can help policymakers, technologists, and the general public collaborate more effectively.

Individual perceptions and attitudes about GHG emissions and RE are critical for understanding how people will react to an effective mitigation policy. Furthermore, public opinion can reveal which policies are aligned with the needs and desires of local populations, who will suffer economically and socially as a result of any effort to significantly reduce US GHG emissions, particularly in China, the US, and countries with extensive coal, oil, and gas extraction. Studies on people's perceptions and attitudes toward RE help policymakers develop long-term RE strategies (Oluoch et al. 2020). Top-down decisions must be replaced with a participatory process including all stakeholders as part of the transition (Lennon et al., 2019; Lange and Cummins, 2021; O'Connor et al., 2022). Understanding public perceptions of energy technologies is critical for constructing a more sustainable future (Sutterlin and Siegrist, 2017; O'Connor et al., 2022).

Among environmental social scientists, perceptions toward RE and support for new technologies are currently hot topics. Many surveys and studies indicate that public perceptions regarding RESs are usually favorable (Ansolabehere and Konisky, 2009; Bidwell, 2016; Ek, 2005), since renewable energies are widely viewed as a partial solution to a number of contemporary societal issues. Djurisic et al. (2020) identified the attitudes and public perceptions towards the RES in Montenegro. This study found that behavior towards RES is most influenced by perceptions and attitudes about RES, followed by awareness/knowledge of RES. In order to create effective RE policies, it is important to understand the level of public support, as well as willingness to pay for RE [19]. Lin and Syrgabayeva [16], who state that consumer's concerns about RES have a positive impact on their attitudes, further enhancing their environmental awareness and increasing their willingness to pay more for RES.

If perception factors are not considered, well-designed RE policies will be less effective. Public support for policies is frequently influenced by how the public processes information and perceives risks, as well as other perceptional factors such as trust in government and the private sector. To successfully design, communicate, and implement national and international alternative clean energy policies, a thorough understanding of the public's perceptions of the threats posed by climate change (CC) and how these perceptions influence public support for RE policies is required (Hagen and Pijawka, 2015). However, since there are observable social and economic costs associated with the incorporation of RES into national energy plans, the public's perceptions of their use should be investigated.

2.4. Quality of Life

Quality of life (QOL) is a multidimensional term comprised of numerous interconnected components that aims to evaluate the well-being of a population across multiple dimensions. Both material conditions and the subjective well-being (Estoque et al., 2019). Income, employment, and housing conditions are the three components of material living conditions. Health, education, environmental quality, personal security, civic engagement, and work-life balance are intangible components of quality of life. A good education, for instance, may result in a higher salary and, consequently, better living conditions (Federal Statistical Office, 2014; OECD, 2023).

The effects of nonrenewable energy, such as coal, natural gas, petroleum oil, and fossil fuel, on quality of life (QOL) in 43 Sub-Saharan African (SSA) economies from 1990 to 2017 were evaluated using three QOL variables (life expectancy, mortality rate, and human development index) in one study (Ibrahim et al., 2021). According to the findings, nonrenewable energy has a negative influence on life expectancy and the human development index, but a good impact on mortality rate (infant). This study indicated that the government should establish policies to help reduce the increase in nonrenewable energy consumption. This can be achieved by encouraging additional investments in RE, which is available but underutilized in the region. Supporting RES and products in the region will also make them more inexpensive, accessible, and a near-perfect substitute for non-renewable energy. Similarly, Ntanos et al. (2018) revealed that using renewable energy sources can contribute toward improving citizens' life quality. Sheikh et al. (2016) classified the social impacts of renewable energy projects into four categories: a) public perceptions include esthetics, lifestyle impact, social benefits, impact on property values, b) employment include job creation, employment diversity addition, poverty alleviation), c) health and safety include public safety, work safety, and d) local infrastructure development includes the development of infrastructure and local empowerment.

Similarly, Shoaib and Ariaratnam (2016) investigated the economic and social impacts of community-based RES projects in two Afghan towns, both at the community and family levels. According to the survey results, the most positively regarded social benefits on the home level were personal security, family contact, and children's learning conditions. In contrast, household economic impacts were assessed as rather minor, with the reduction in energy costs being the most significant. On the level of the community, the most significant perceived economic impacts were job creation and the improvement of small businesses, whereas the most significant social impacts were the improvement of education and health care services (Karytsas et al., 2020).

3. METHODS

This section presents the research approach designed to investigate the perceptions and attitudes on the RE projects for energy transformation under China's NDCs and their impact on the quality of life. This study has adopted a mixed approach, including descriptive and quantitative methods, to collect and analyze the data. The target population of this study is formed by residents of Linfen city with ages of 18 years and above. The sample size was 402 respondents calculated by Taro Yamane (Yamena, 1967). Despite the fact that the sample is not statistically typical of the total population, it provides insight into how the public perceives RE developments under China's NDCs spolicy and their attitudes toward the impact on quality of life.

The survey assessed individuals' knowledge, perceptions, and attitudes of China's NDCs energy transformation policy. By using age, gender, income and occupation, environmental quality, cost of living, and life expectancy, the RE project's key impacts on quality of life were investigated. This study examined the positive and negative effects of China's NDCs on the economic, environmental, and social wellbeing of Linfen citizens. For the research hypothesis anticipates that

1. Energy restructuring based on China's NDCs would provide greater economic, environmental, and social benefits for Linfen citizens
2. RE projects based on China's NDCs would improve Linfen's quality of life.

The questionnaire was prepared with reference to those used in related studies (e.g., Kardooni et al., 2016, Alsabbagh, 2019, GOV.UK, 2021). The sample population was determined and identified using a snowball sampling technique. Data from participants was collected through an online questionnaire-based survey. A questionnaire-based quantitative study approach was used to collect demographic, perception, attitude, and the effects of China's NDCs on Linfen people' quality of life. This survey was distributed through online platform, called "Wen Juan Xing", which is a Chinese online survey tool. These questionnaires were conducted between August and October 2022. Online surveys are faster, cheaper, and more secure in protecting respondents' privacy (Grossardt and Bailey, 2018). As a result, the study chose the online survey method. The survey link was sent via email and social media after the sample participants were chosen. In addition, recipients were asked to share the link with local connections.

The questionnaire consisted of five sections. First, we asked about the demographic characteristics, including age, gender, education background, occupation, income level, and living area. Secondly, respondents were asked about the perceptions of China's NDC policy towards climate change in Linfen city. Third section

gathered a set of questions based on knowledge and support of China's NDCs. Fourth section, Respondents were asked about their perception on China NDCs towards the RE projects in Linfen city. Next, fifth section gathered a set of questions about attitudes toward the impact of RE energy projects on quality of life including economy, environmental quality such as air pollution, life expectancy, consumer choice, living conditions, health, and job creation. In addition, respondents were asked to rate the impact of the development of RE projects in accordance with China's NDCs for energy restructuring for both economic and social aspects.

This study employed nominal and ordinal scales (i.e., the Likert scale). Nominal scales were used to determine demographic characteristics including as gender and age, while ordinal scales (five-point Likert scales) were used to study citizens' perceptions and attitudes regarding the China NDCs and the impact of RE projects in Linfen city. Cox (1980) proposed that scale points between five and nine should be used based on the circumstances. The Likert scale is a five (or seven) point scale that allows individuals to indicate their level of agreement or disagreement with a particular statement. In this study, the five-point scale was applied because it is employed in many studies of public perceptions on renewable technology acceptance (Abdmouleh et al., 2018, Rezaei and Ghofranfarid, 2018, Alsabbagh, 2019, Duarte et al., 2022).

The responses from the Wen Juan Xing online survey were stored in an Excel spreadsheet before being converted to SPSS (Statistical Package for the Social Sciences) Statistics Amos version 21.0 for descriptive statistical analysis.

4. RESULTS

As stated previously, the data was collected from Linfen citizens. The demographic characteristics of the respondents are provided in Table 1. Approximately 53 % of respondents were female. The majority of respondents were between the ages of 21 and 40. To address the public's concerns about climate change. Capstick et al. (2015) and Kardooni et al. (2016) asked their participants how concerned they were about climate change. According to this study, 72.14% of Linfen residents were concerned about climate change. Only 2.99% of the population in Linfen city stated that they were not at all concerned about climate change, indicating a high level of concern about the issue.

In addition, participants were asked about their awareness of China's NDC policy to mitigate climate change. More than 60% of respondents were aware of China's NDCs policy, which is comparable to the previous rate of climate change concern. The majority of citizens are more concerned about national climate change policies. However, only 51.49% of the respondents said they were aware of the environmental policy in their city. The result wasn't in line with their awareness of the significance of climate change. It is crucial to recognize that people have inadequate knowledge about local environmental policies. In the following section, the extent to which individuals are aware of and support NDCs is explored. Participants were asked about their knowledge of NDC policy. In spite of this, the results revealed that 42.79% of respondents knew a little bit about the NDCs, while 25.12% and

Table 1: Demographics variables of the respondents

Demographic variables	Category	Percentage
Gender	Male	44.28
	Female	52.74
	Do not wish to disclose	2.68
Age	Below 18	8.96
	21–30	29.10
	31–40	37.06
	41–50	21.89
	51–60	1.99
	Above 60	1
Education level	High school	6.22
	Bachelor's degree	55.22
	Postgraduate/Master degree	29.85
	Doctoral	2.49
	Others	6.22
Occupation	Student	13.18
	Part-time employment	2.74
	Full-time employment	70.40
	Self-employed	5.72
	Housework/parenting	2.24
	Unemployed	1.49
	Retired	4.23
Income level	<3000 yuan	15.67
	3001–6000	27.61
	6001–9000	19.40
	Above 9000 yuan	37.31
Residential area	Urban	78.86
	Sub-urban	15.67
	Rural	5.47

21.6% had "heard of it but don't know much about it" and "never heard of it before," respectively, as shown in Figure 2. This might be interpreted as China's failure to publicize its NDC policy and the public's lack of awareness or interest in this matter.

Previous studies have shown that respondents' awareness of RE increased with their level of education (Szakály et al., 2020; Mahmood, 2020; Wang et al., 2022). Similarly, the result of this study showed that people with a higher level of education tend to have higher knowledge of China's NDCs policy (Figure 3). Respondents with a university degree had a considerably higher understanding of China's NDC policy than those with a high school education, which is consistent with previous studies. Previous research in Malaysia (Kardooni et al., 2016) and southern Jordan revealed that environmental awareness and knowledge of RE rose with education level (Al-Smadi et al., 2022).

The survey also investigated citizens' knowledge and support toward the country's goal of achieving carbon neutrality by 2060, which is a significant driving force for China's energy reform. Regarding the carbon peaking and carbon neutrality goals, the situation changes. As shown in Figure 4, 297 respondents (74.62%) agreed with the goals, while 19.10% indicated they had no idea what the goals were and <10% do not. This demonstrates that China's carbon peaking and carbon neutrality goals have received adequate awareness, and the majority of individuals have their own opinions regarding this policy. For building of a low-carbon energy system, the reduction of CO_2 emissions, and the increase of non-fossil energy consumption are crucial tasks. In relation to this, as shown in Figure 5, most of respondents agreed the country aim to increase the share of non-fossil fuels RE such as

Figure 1: Linfen map

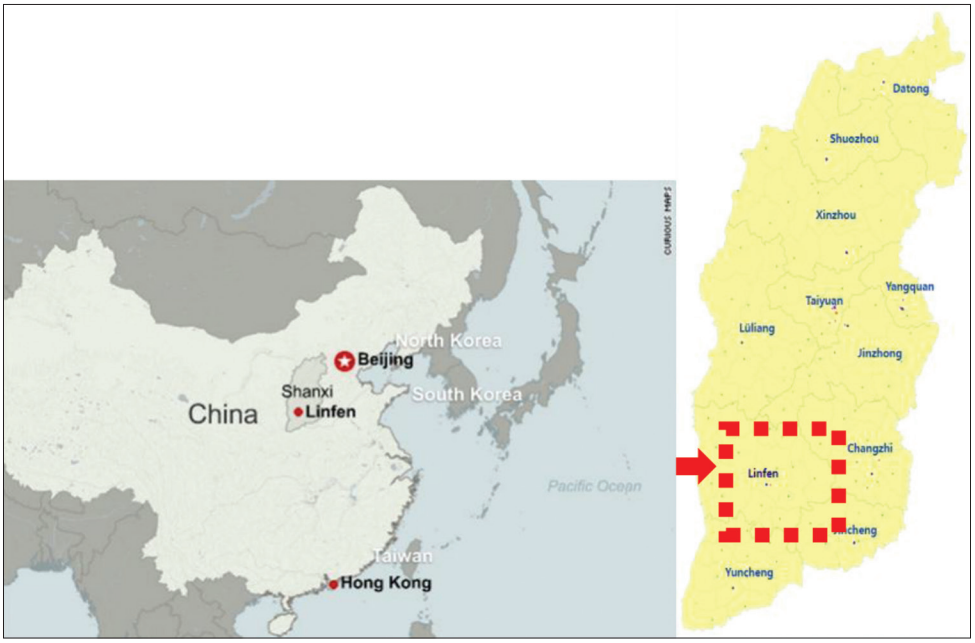


Figure 2: Respondents' knowledge on NDC policy

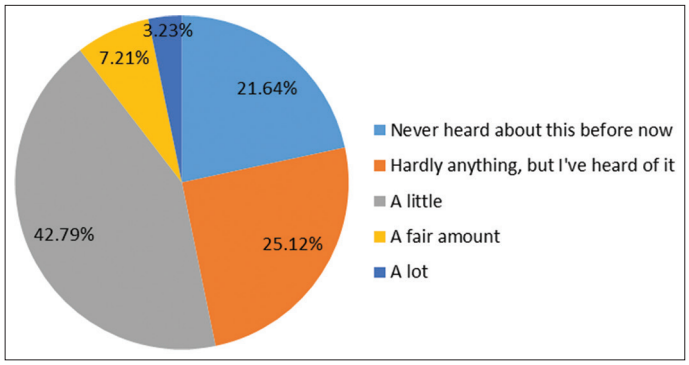
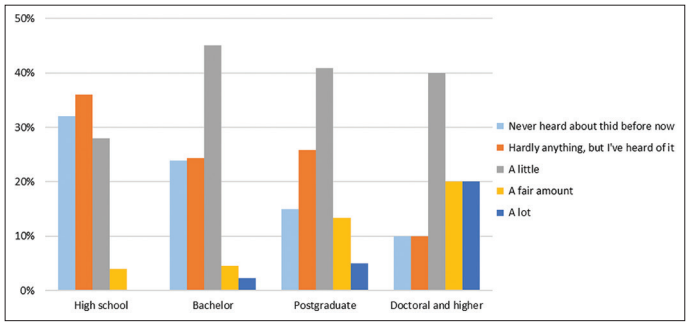


Figure 3: Knowledge of China's NDC policy by educational level of respondents



solar, wind etc. in primary energy consumption to around 25%. When it comes to the country aim to increase the use of wind and solar power for replacing fossil fuel and reduce greenhouse gas emission. Surprisingly, about 80% of respondents agreed to support RE and China's NDC targets. The revolution of energy and China's NDC targets are in high demand.

In the questionnaire used in this study, respondents were also asked their attitudes towards the impact of RE projects on quality

Figure 4: Attitude toward the carbon peaking and carbon neutrality goals

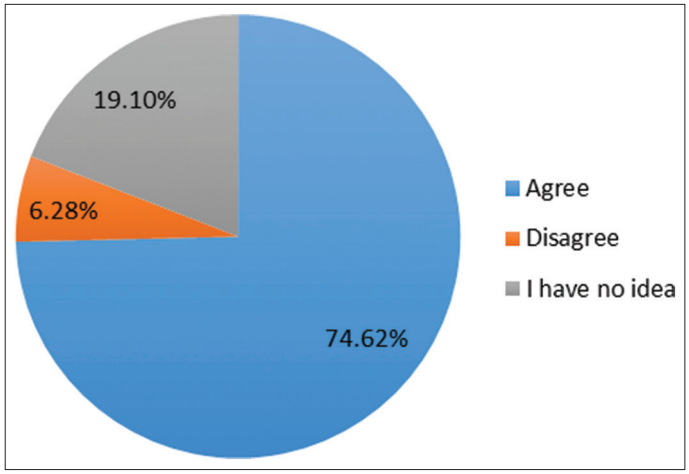
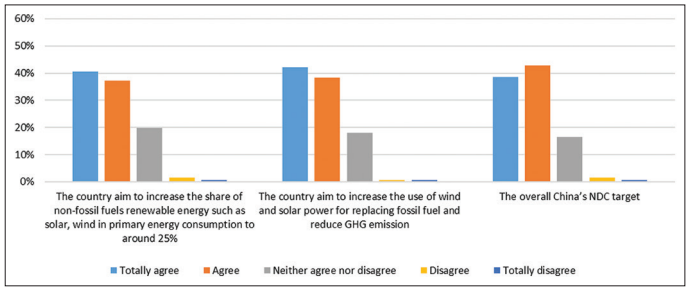


Figure 5: Perceptions of China's NDC targets and the use of RE



of life. It is important to understand individuals' attitudes toward RE projects in order to shape future implementation strategies for energy transformation.

Since Linfen city has been dominated by coal for economic development. It may face some challenges regarding energy transformation toward RE energy projects. Therefore, it is critical

to comprehend individuals' attitudes on the impact of RE projects on quality of life. As shown in Figure 6, the majority of Linfen citizens agreed that the development of RE projects according to the China's NDCs for energy restructuring may improve health, life expectancy, living condition such as level of pollution, access to clean water and environmental quality such as air pollution. More than 80% of respondents had a positive attitude, demonstrating that the promotion of the transformation to the living conditions of Linfen residents is highly valued. Similar to citizens in Greece has positive attitudes on RE contributes to citizens' life quality and encourages them to invest in renewables (Ntanos et al., 2018).

On the other hand, citizens' attitudes regarding the impact of the energy transformation on their overall quality of life and extra spending to support the electricity generated from RE varied. The majority of respondents believed that the development of RE projects in accordance with China's NDCs for energy restructuring could reduce carbon emissions and improve overall quality of life. Yet, approximately 67.66% of respondents were willing to pay a higher monthly payment to promote the use of RES. It can be noticed that about 11% of respondents were unwilling to pay more in monthly bills to support electricity generated from RE sources as shown in Figure 7. They maintain a positive attitude toward the additional expenses, but the number of individuals who are

Figure 6: Attitudes toward the impact of RE energy projects on quality of environment and health

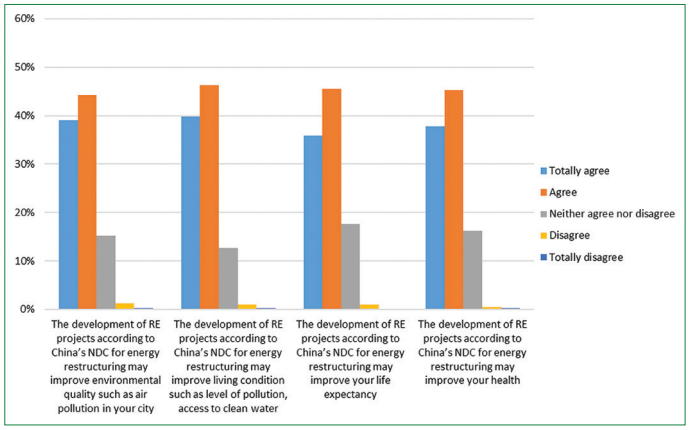
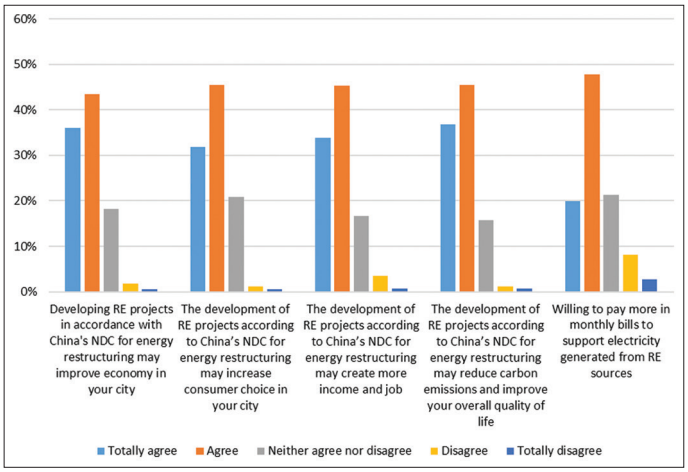


Figure 7: Attitudes toward the impact of RE energy projects on society and economy



completely in agreement is still small, demonstrating that people's willingness to pay more to support green energy is restricted. The development of RE consumption has the potential to enhance investments in sustainable energy (Wall et al., 2021). Despite slightly higher electricity prices when compared to conventional fossil fuel energy products, a study of consumer attitudes toward RE products reveals an increasing willingness to support RE development. Consumers in New Zealand are willing to spend 2% more than their existing power rates to boost the country's proportion of RE products (Ndebele, 2020).

Results from Spearman correlation analysis revealed a significant association between the development of RE projects in accordance with China's NDCs can improve quality of life, including economy, environmental quality, life expectancy, consumer choice, and health ($P<0.01$) as shown in Table 2.

Finally, the attitude toward the development of RE projects in accordance with China's NDCs for energy restructuring is described in terms of its impact on China's economic and social aspects. On a 5-point scale ranging from disagree to agree, the attitude of the respondent towards the RE projects was measured based on the respondent's evaluation of the impact. This measurement enabled respondents to incorporate their existing knowledge and the perceptions of personnel regarding RE technology. As shown in Table 3, the observed attitude level on economic and social dimensions was quite positive, as shown in Table 3. Most economic aspects evaluated the development of RE projects in accordance with China's NDCs as having a favorable influence on local material and business opportunities, while public health revealed a significant positive impact on social aspects. In addition, results from spearman correlation revealed a significant correlation between the development of RE projects and economic (0.256, $P<0.01$) and social (0.307, $P<0.01$) aspects, as shown in Table 4. The result shows that Linfen citizens' attitudes about the development of RE projects under China's NDCs have a positive impact on the economic and social aspects of the city. This finding provides evidence that China has consistently prioritized the implementation of NDC targets as a critical measure to advance the comprehensive transition towards environmentally friendly and low-carbon practices in economic and social development.

5. DISCUSSION

The survey response revealed the extent of perception and attitude toward the use of RE for energy restructuring based on China's NDCs. The respondents demonstrated a moderate level of concern for climate change. They believed that the government should play a leading role in response to climate change. Even though they expressed a fair knowledge of local environmental policies and awareness regarding China's NDC policy, the majority of respondents support the country's goal of carbon peaking and carbon neutrality targets before 2030 and 2060, which is a significant driving force for China's energy reform. The acceptance of local citizens is an essential requirement for the implementation of energy initiatives and the achievement of energy policy (Sütterlin and Siegrist, 2017). In addition, they expressed strong support for China's NDC targets of increasing the share of RE, such as wind and solar power, in primary

Table 2: Spearman correlation analysis of question "How much do you agree with and support the development of RE projects such as wind and solar in your city in accordance with China's NDCs for energy restructuring?" and the impact of RE energy projects on quality of life

Items	How much do you agree with and support the development of RE projects such as wind and solar in your city in accordance with China's NDCs for energy restructuring?
Improve economy in your city	0.688**
Improve environmental quality such as air pollution in your city	0.692**
Improve your life expectancy	0.575**
Increase consumer choice in your city	0.603**
Improve living condition such as level of pollution, access to clean water	0.632**
Improve your health	0.533**
Create more income and job	0.512**
Reduce carbon emissions and improve your overall quality of life?	0.518**
How much do you willing to pay more in monthly bills to support electricity generated from RE sources	0.367**

*P<0.05 **P<0.01

Table 3: Attitude toward the development of RE projects in accordance with China's NDCs for energy restructuring on economic and social aspects

How much do you believe that the development of RE projects in your city in accordance with China's NDCs for energy restructuring can have a positive impact on the following economic aspects?	AVE
Local economy	3.68
Local labor from rural areas	3.56
Local material and business opportunities	3.71
Local shareholders opportunity	3.61
Services of local banks	3.68
How much do you agree the development of RE projects according to China's NDCs for energy restructuring in your city can improve social aspect on following?	
Educating the community about climate change	3.74
Community living standards	3.7
Social bonds creation	3.69
Public health	3.79

Table 4: Spearman correlation between attitudes on China's NDC towards the RE projects in Linfen city and impacts on economic and social aspects

	How much do you agree with and support the development of RE projects such as wind and solar in your city in accordance with China's NDC for energy restructuring?
NMMS_economic	0.256*
NMMS_social	0.307**

*P<0.05 **P<0.01

energy consumption to replace fossil fuels and reduce greenhouse gas emissions. The preference for RES is consistent with that of emerging economies such as Brazil, India, South Africa, and Russia (Chen et al., 2022). An interesting finding of the present study also revealed that a higher level of education is associated with greater awareness and understanding of RE, which can lead to a higher willingness to pay for renewables. It can be emphasized that early education on RE is crucial for future generations' environmental sustainability and preservation. The government should ensure that more people are educated on RE, as this would facilitate the deployment of RE's significance in reducing environmental pollution, boosting the economy, enhancing energy security, and creating employment (Kumar and Choudhary, 2022). For other individual variables, our result indicated that there is a similar proportion between male and female on perception and awareness on climate change and national climate policies. Numerous studies have indicated that, on average, females show a slightly higher degree of environmental concern and show stronger pro-climate opinions and beliefs compared to males (Zelezny et al., 2000; Climate Communication Gender, 2018; Li et al., 2022).

Regarding the impact of RE projects on their quality of life, most respondents were optimistic. In addition, they were positive that RE projects under China's NDCs would contribute to economic in terms of local materials and business opportunities, local banks, local economy, local labor, and local shareholder opportunities, as well as social benefits in terms of improved public health,

community living standards, climate change education, and social bonding. RE project developments create new employment and investment opportunities, particularly on local markets, and should effectively contribute to the social and economic development of any economy. Solar PV is the main source of RE employment in China with an estimated workforce of nearly 2.7 million, up from 2.3 million in 2020, and offshore wind is generating an increasing number of jobs. China has the highest indirect employment creation per GWh of generation, at 104.4 jobs/GWh, while wind has the average, at 45.4 jobs/GWh (Wang et al., 2013). Solar CDM projects have the greatest potential for creating additional jobs in China. Therefore, the Chinese government should promote RE sectors to foster long-term growth. By nurturing an enabling environment, the formulation of local energy policy has the potential to facilitate the realization of the societal benefits associated with RES.

A growing number of countries are acknowledging the diverse opportunities that exist and are adapting their domestic energy strategies to align with societal advantages. They are actively seeking and developing a new energy landscape that focuses on renewable sources. The concept has emerged as a legitimate framework with multiple advantages, integrating environmental imperatives such as mitigating climate change with economic and social goals. The potential for local value creation lies in activities such as technological research, manufacturing, installation, and maintenance. Additionally, there is an opportunity to enhance energy access in a timely manner and improve air quality to promote a healthy environment. Linfen has been consistently affected by enduring and severe air pollution, ranking last among 169 major cities in China with the worst air quality (Ji et al., 2023). This undesirable condition can be attributed to the city's substantial industrial sector, which encompasses the production of coal, coke, steel, and electricity. It is essential for the government to enhance the energy infrastructure by implementing measures that facilitate the expansion of clean energy utilization and promoting the adoption of RE technologies.

6. CONCLUSION AND RECOMMENDATION

This study was conducted to investigate citizen perceptions and attitudes toward energy transformation for quality of life based on China's NDCs. The finding showed that Linfen citizens had a moderate awareness of climate change and China's NDC policy. The majority of participants had a positive attitude toward the utilization of RE to improve their quality of life in terms of economic and social aspects. They supported the development of RE projects based on China's NDC targets, despite the fact that the level of willingness to pay higher monthly bills to support RE electricity was fairly average.

In addition, while most citizens are concerned about climate change, many are unfamiliar with local environmental regulations and China's NDCs. It should be emphasized that public engagement and education are crucial for attaining climate neutrality. To accomplish the goals, participation must be meaningful for both citizens and institutions. To develop and successfully implement policy responses, the government, the public, and the experts must collaborate. To achieve China's NDCs, the government should encourage businesses, communities, and individuals to modify their behavior to avoid these environmental issues. These environmental concerns are wholly realizable with public awareness, cooperation, and willingness. Furthermore, it is essential at the local level to develop public outreach programs that facilitate communication between multiple stakeholder groups, such as government, corporations, specialists, non-governmental organizations, and residents.

The industrial structure of Linfen is characterized by a significant number of coal, coke, steel, and electricity sectors, which are the predominant industries in the region. Consequently, this heavy industrial structure contributes to the generation of substantial volumes of industrial emissions. The heavy industry sector should promptly undertake a transition towards ultra-low emission processes to effectively mitigate the presence of air pollutants in the flue gas and enhance its environmental management regulations. The current energy landscape is primarily characterized by a heavy reliance on coal as the dominant energy source. To address environmental issues and promote sustainable development, it is critical to increase the use of cleaner usage technologies and make structural changes that allow for the incorporation of cleaner alternative energy sources. Furthermore, more efficient measures for decreasing emissions in Shanxi and surrounding provinces are required to decrease regional emissions. In response to China's NDCs and dual carbon policy, Linfen has lately achieved tremendous progress in RE initiatives. A growing number of projects including wind power, solar systems, pump storage, hydrogen fuel, and the continuous enhancement of alternative energy sources highlights the outstanding achievements in the field of clean energy.

These findings can help policymakers promote the expansion of RE sectors to foster long-term growth and improve the quality of life for Linfen's residents. The formulation of local energy policy has the potential to facilitate the realization of the economic and social benefits associated with RES by nurturing an enabling environment. To maintain this momentum, further studies should be conducted to bridge the gap between raising public understanding of climate change in China and mobilizing public engagement, particularly to improve willingness to pay for RE.

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8. DECLARATION OF COMPETING INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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